

The Albuneidae (Decapoda: Anomura: Hippoidea) of the Hawaiian Islands, with description of a new species

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Abstract.—*Albunea danai*, a new species that has been confused with *A. speciosa* Dana, is described from Oahu, Hawaii. The new species actually resembles *A. carabus* (Linnaeus) from the Mediterranean and western Africa. The discovery of this new species brings the total number of Indo-West Pacific members of the genus to eight. *Albunea speciosa* is broadly distributed in the Indo-West Pacific and is not a Hawaiian endemic as previously believed. As the identities of the two Hawaiian species have been confused, *A. speciosa* is here redescribed from new material and a neotype is selected. Both *A. danai* and *A. speciosa* are discussed using newly defined morphological characters.

Albunea speciosa Dana, 1852, is the only species of albuneid heretofore known from the Hawaiian Islands and has been considered a Hawaiian endemic (Serène 1973). In the course of examining specimens of sand crabs for a worldwide revision of the family Albuneidae, material from Hawaii was found labeled “*Albunea speciosa*” and “*Albunea symnista*” [sic] in the collections of the Western Australian Museum (WAM), but that was clearly not conspecific with *A. speciosa*. Later, additional Hawaiian specimens were obtained from the Bernice P. Bishop Museum that were labeled “*Albunea thurstoni*” that clearly are not *A. thurstoni* Henderson, 1893, but instead are the same taxon as the WAM material. Since these specimens cannot be placed in any known species of albuneid, they are described here as a new species. In addition, my examination of specimens that are referable to *A. speciosa* revealed that this species is not endemic to Hawaii, but has a broad range in the Indo-West Pacific. Because the faunal composition and biogeography of island groups has attracted much attention of late and the fact that more than one species has been repeatedly identified

with *A. speciosa*, that species is redescribed from new material and a neotype is designated herein in order to fix its identity. This description of the new species brings the total number of Indo-West Pacific species of *Albunea* to eight: *A. symmysta* (Linnaeus, 1758), *A. speciosa*, *A. microps* Miers, 1878, *A. thurstoni*, *A. elioti* Benedict, 1904, *A. steinitzi* Holthuis, 1958, *A. madagascariensis* Thomassin, 1973, and *A. danai* new species.

Materials, Methods, and Morphological Terminology

Materials.—Specimens for this study came from the collections of the American Museum of Natural History, New York (AMNH), Bernice P. Bishop Museum, Honolulu, Hawaii (BPBM), California Academy of Sciences, Invertebrate Zoology, San Francisco (CASIZ), Musée Royal de l’Afrique Centrale, Tervuren, Belgium (MRAC), Queensland Museum (QM), University Museum of Zoology, Cambridge (UMZC), National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM), Western Australian Muse-

um, Perth (WAM), and Yale Peabody Museum, New Haven, Connecticut (YPM).

Methods.—Carapace length (CL), as measured from the midpoint of the anterior margin (including rostrum) to the midpoint of the posterior concavity, is provided as an indicator of specimen size. In the list of synonyms, asterisks refer to publications citing material examined during the present study. Absence of an asterisk in a specific entry does not imply that the identifications therein are in doubt, but only that it was not possible to examine the material cited in that publication.

Illustrations were created using a modified approach of Harvey & De Santo (1997). Specimen images were first captured on a Macintosh™ computer with a digital camera connected to a Wild M8 dissecting microscope. These images were then prepared using the programs Adobe Photoshop™ and Adobe Illustrator™. I attempted to record the position and size of setae in these drawings as accurately as possible, although for clarity of presentation the plumules of plumose setae were not drawn.

Morphological terminology.—During the course of this study and that of Boyko & Harvey (in press), several important diagnostic morphological features were encountered that have not been described previously for albuneids. Although these, along with other features, are discussed in Boyko & Harvey (in press), they are also considered here to facilitate a clearer understanding of the descriptive terms used in this paper.

The front of the carapace of albuneids bears a broad mat of very short, dense, simple setae. This mat, hereafter called the setal field, varies in shape and extent across genera and species, but appears to be relatively invariant within species. The carapace also possesses numerous transverse, setose grooves. Although carapace grooves (CG) have been scarcely mentioned by previous authors, 11 major grooves (numbered 1–11, Fig. 1) have been identified which

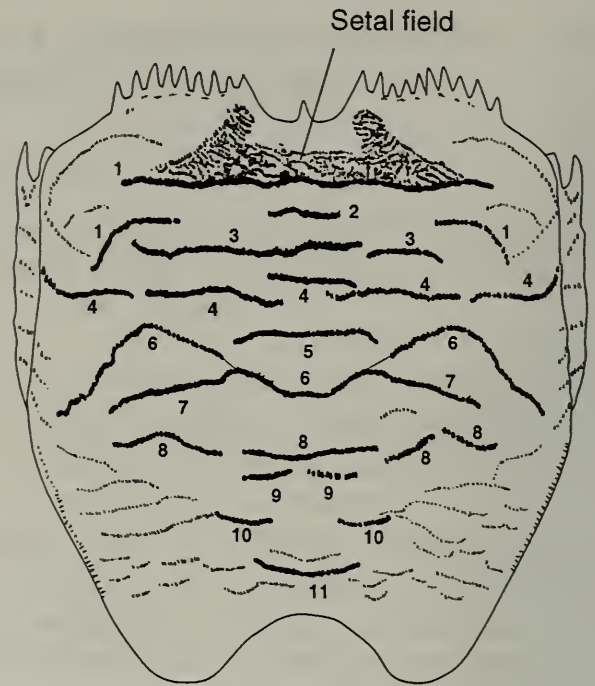


Fig. 1. Diagrammatic albuneid carapace based on *Albunea microps* Miers, 1878, showing setal field and setose carapace grooves (CG 1-11) discussed in text.

can be recognized across albuneid genera. Variability in the presence and the degree of fragmentation of specific grooves, in the anterior-posterior displacement of individual fragments, and in the texture of the grooves (e.g., smooth, crenulate) tends to be conservative within species, and thus carapace grooves are useful in recognizing species.

Because several of the specimens examined during this study were incorrectly sexed, brief remarks on the determination of male and female identity in albuneids are presented here. As in most decapod crustaceans, albuneid females have gonopores on the coxae of the third pereopods, whereas males have gonopores on the coxae of the fifth pereopods. However, in some albuneid genera (e.g., *Lepidopa* Stimpson, 1858 and some *Albunea*, including both species from Hawaii), males also have a small pore on the coxa of the third pereopod in a position analogous to that of the female gonopore. The precise nature and function of this pore is unknown.

In albuneids, females have well developed uniramous pleopods on abdominal so-

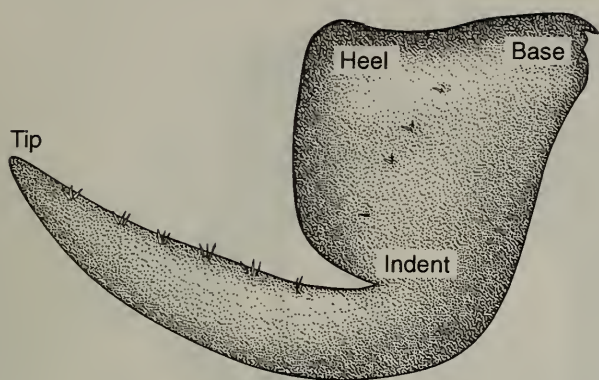


Fig. 2. Pereopod II dactyl of *Albunea* sp., lateral view, showing terms used in species accounts for landmarks on pereopod dactyli.

mites II–V. Male albuneids have traditionally been considered to lack pleopods (Eford & Haig, 1968). However, rudimentary or small pleopods were found on abdominal somites II–V of male specimens with well developed gonopores on the fifth pereopods in species of several albuneid genera (e.g., *Lepidopa*). In some *Albunea* species (e.g., *A. microps*, *A. speciosa*), specimens with large pores on the fifth pereopods and with small pores on the coxae of the third pereopods, show no signs of pleopod development. In those species in which the male pore occurs, it is always smaller than gonopores of same-sized females; likewise, the pleopods of females are always much more developed than those of males. Males are most reliably recognized by the presence of a gonopore on the fifth pereopod and the rudimentary degree of development of the pleopods or lack thereof. In small specimens, however, the presence or absence of the male gonopore is a more reliable indicator of sex than is pleopod development because both males and females may have small pleopod buds as juveniles.

The shape of the dactylus of the pereopods, particularly the third pereopod, has been used to distinguish among species of albuneids. To facilitate the description of the complex shape of this segment, several terms are used to refer to important landmarks (Fig. 2). The “base” of the dactylus is the ventroproximal angle; the “heel” corresponds to the dorsoproximal angle, which

is often strongly produced. The dorsal margin is almost always concave, sometimes smoothly so; in most species, however, the dorsal margin has a distinct angle, the apex of which is referred to as an “indent.” The dactylus terminates in a “tip,” which is somewhat rounded and lacking in a corneous nail.

In some species of albuneids, certain segments of the pereopods bear a large transparent, decalcified area, hereafter called the “window,” that has not been previously reported in this family. This area, when present, is most prominent on the lateral surface of the merus, where it is comparable to the “leg membranes” of porcelain crabs (Porcellanidae) discussed in detail by Stillman & Somero (1996). These windows can also be found to a lesser degree on other pereopod segments, both laterally and medially.

Superfamily Hippoidea Latreille, 1825

Family Albuneidae Stimpson, 1858

Albunea Weber, 1795

Albunea speciosa Dana, 1852

Figs. 3, 4

Albunaea speciosa Dana, 1852: 405–406; 1855: pl. 25, figs. 6a–f.—Stimpson, 1858: 230 (list).

Albunea speciosa.—Miers, 1878: 315 (list), 331 (after Dana, 1852).—Ortmann, 1896: 223 (key), 225 (list), 239 (table).—Gordon, 1938: 187 (list).—Edmondson, 1946: 266.—Serène, 1973: 262–263, pl. 2. “*?Albunea speciosa*”.—Borradaile, 1904: 751*.

Material examined.—Neotype: Hawaii, Oahu, 27 May 1938: 1 male, 9.0 mm CL (USNM 260868); same data as neotype: 2 males, 9.5–10.4 mm CL, 1 female, 14 mm CL (USNM 287087); Kailua, Oahu, Mar 1938: 1 male, 10.1 mm CL (BPBM S11781); Honolulu Harbor, Oahu, coll. E. M. Ehrhon, Dec 1916: 2 males, 6.4–9.9 mm CL, 1 female, 7.3 mm CL (CASIZ 109240); Halonu Blow Hole dive site, south shore, Oahu, coll. R. Holcom, 3 Aug 1997: 1 fe-

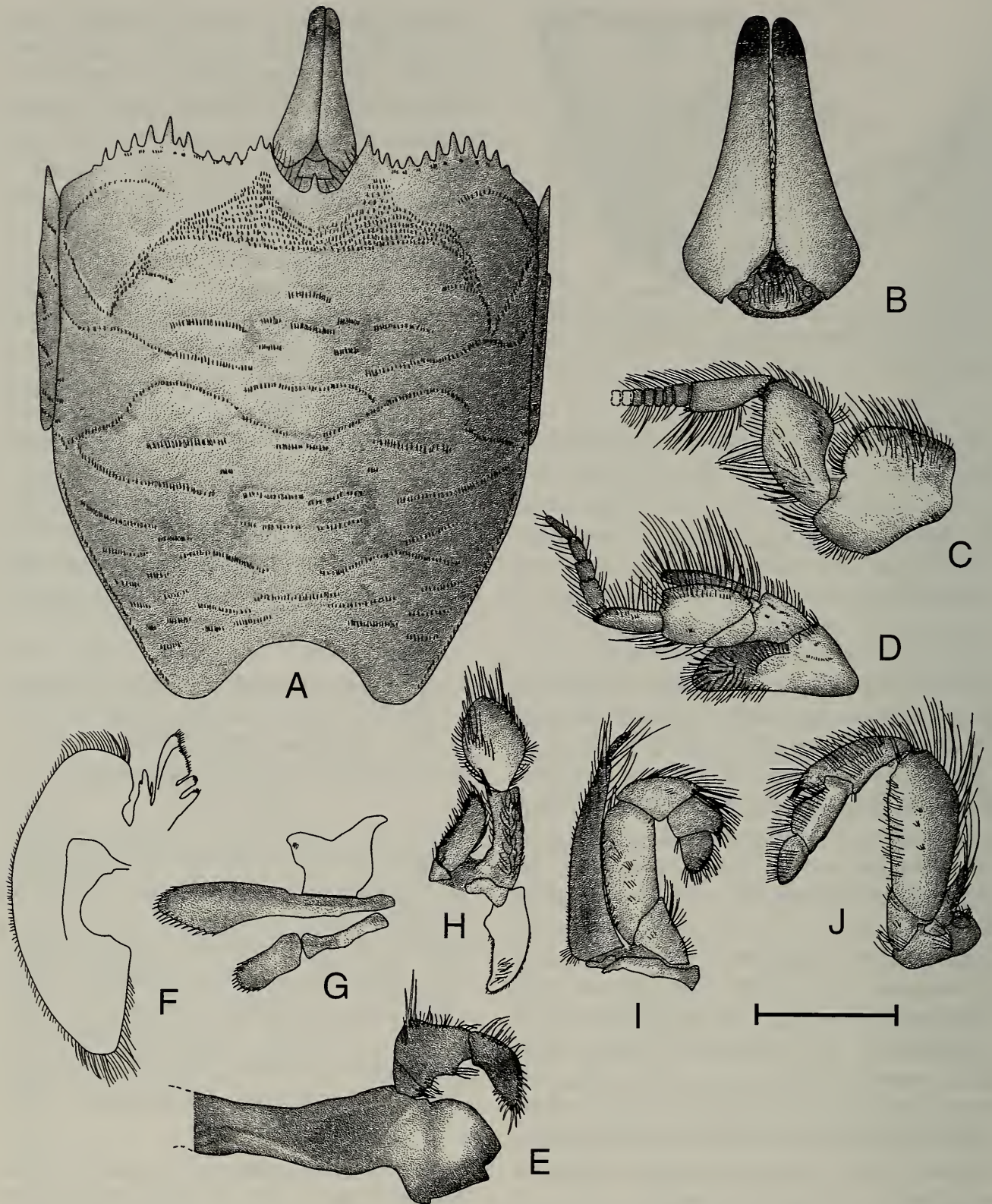


Fig. 3. *Albunea speciosa* Dana, 1852. A, male, 9.0 mm CL, USNM 260868, neotype; B–J, male, 10.4 mm CL, USNM 287087. A, carapace and eyes, dorsal view; B, eyes, dorsal view; C, left antennule, lateral view; D, left antenna, lateral view; E, left mandible; mesial view; F, right maxilla, lateral view; G, left maxillule, lateral view; H, left maxilliped I, lateral view; I, right maxilliped II, lateral view; J, left maxilliped III, lateral view. Scale = 1.6 mm (B, E, G), 2.2 mm (I), and 3.3 mm (A, C, D, F, H, J).

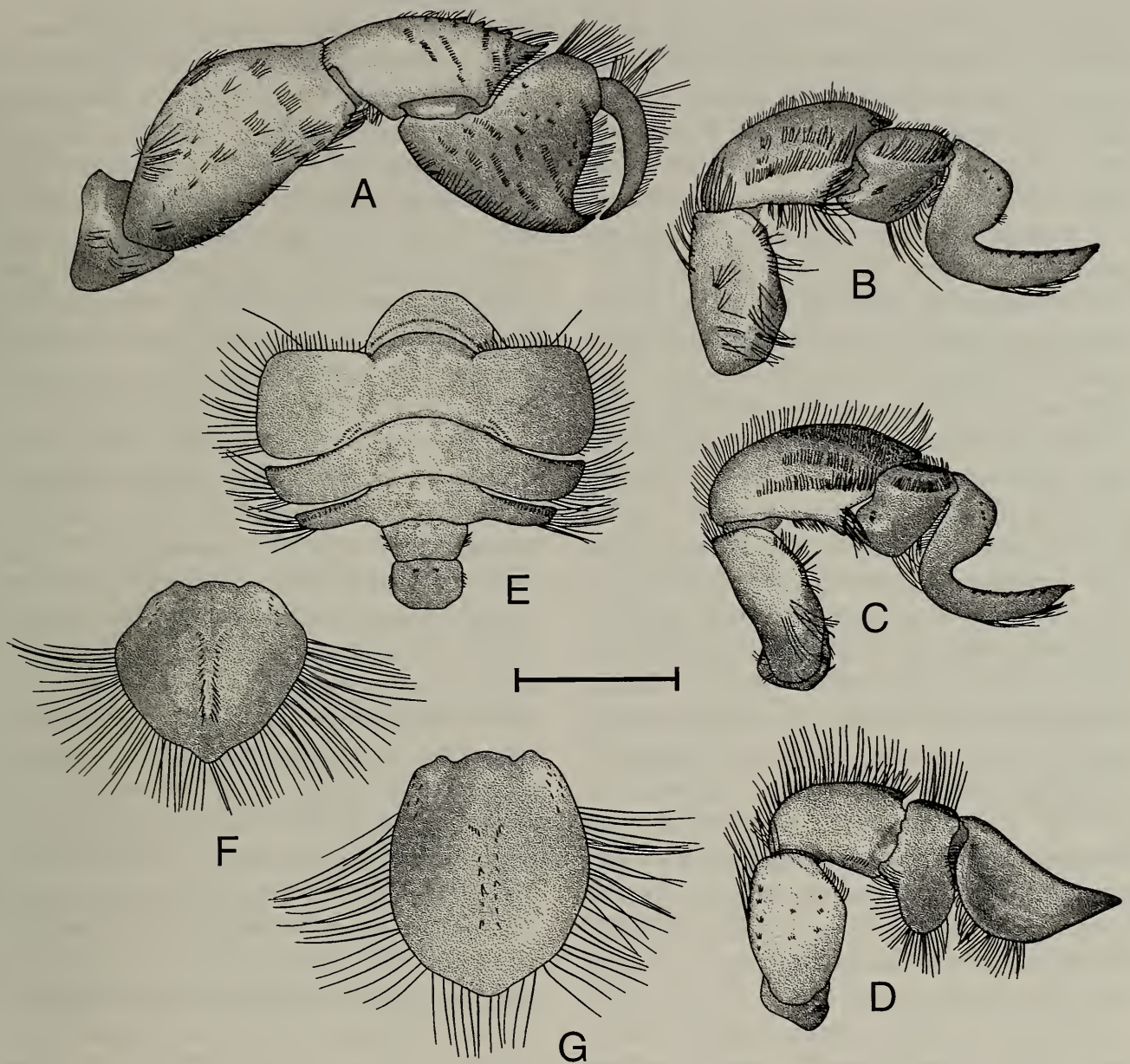


Fig. 4. *Albunea speciosa* Dana, 1852. A-E, male, 10.4 mm CL, USNM 287087; F, male, 9.0 mm CL, USNM 260868, neotype; G, female, 14 mm CL, USNM 287087. A, right pereopod I, lateral view; B, right pereopod II, lateral view; C, right pereopod III, lateral view; D, right pereopod IV, lateral view; E, abdominal somites I-VI, dorsal view; F, telson of male, dorsal view; G, telson of female, dorsal view. Scale = 3.0 mm (F, G), 4.0 mm (A-D), and 4.2 mm (E).

male, 6.6 mm CL, 1 broken unsexable/unmeasurable specimen (QM W22284); Halonu Blow Hole dive site, south shore, Oahu, 12.2-13.7 m, coll. R. Holcom, 4 Apr 1997: 2 males, 6.4-7.1 mm CL, 3 females, 5.7-9.5 mm CL, 6 juveniles, 3.3-4.1 mm CL (QM W22285); Oahu, coll. R. Holcom, Apr 1997: 2 ovigerous females, 7.5 mm CL (QM W22286); "Hawaii," coll. C. M. Cook Jr., 1897: 1 female, 10 mm CL (YPM 21133).

Australia: Bay on north side of Point

Cloates, lee side of reef, Western Australia, 113°38'E, 22°41'S, depth 3.7 m, coll. WAM Ningaloo Expedition, 23 Aug 1968: 1 male, 8.7 mm CL, 1 carapace, 9.1 mm CL (WAM 489-97); southwest of Point Cloates, Western Australia, 113°39'30"E, 22°43'30"S, coll. WAM Ningaloo Expedition, 7 Sep 1968: 1 ovigerous female, 9.7 mm CL (WAM 490-97).

Seychelles: Mahé, coll. Mission Zoologique MRAC-ULB, July-Sep 1966: 1 ovigerous female, 9.9 mm CL (MRAC 53.894).

Maldives: Hulule, Male Atoll, coll. J. S. Gardiner: 1 male, 8.4 mm CL (UMZC).

Type locality.—Sandwich Islands (= Hawaiian Islands) (Dana, 1852) herein restricted by neotype selection to Oahu, Hawaii, USA, Pacific Ocean.

Type material.—It is unclear exactly how many specimens of this species Dana (1852) had before him when writing the description of this species, but the description suggests that there was only one. No type material of this species is extant in either USNM, the Museum of Comparative Zoology, Harvard University, or the British Museum (Natural History) (Evans 1967; Boyko, pers. obs.). Because these institutions are the only known repositories for Dana's extant type material (Evans 1967), the type material of *A. speciosa* must be considered lost. In light of the new information about the range of *A. speciosa*, and the discovery of a new species of albuneid in the Hawaiian Islands which has been repeatedly misidentified as *A. speciosa*, it is appropriate to follow the suggestion of Serène (1973) and select a neotype for the species. A male, 9.0 mm CL (USNM 260868) is herein designated as the neotype for *Albunea speciosa*.

Diagnosis.—Carapace slightly longer than wide, covered with strongly setose grooves. Anterior margin with 13–17 teeth on either side of ocular sinus. Setal field with narrow lateral elements and concave anterior margin; posterior lateral elements extending to posterior lateral elements of CG1. CG1 with separate posterior lateral elements but with anterior and posterior elements united by posterior elements of setal field; CG4 with 2–3 short anteriorly displaced medial elements; CG5 entire, nearly reaching margins of CG6; CG6 and CG7 separate; CG8 with 1–2 median elements separated from lateral elements; CG11 present. Rostrum reaching just beyond proximal margin of ocular plate. Ocular plate subquadrate. Ocular peduncles dorsoventrally flattened and elongate, rounded at tip, approximate along mesial margin; lateral mar-

gin concave; mesial margin straight. Cornea at tip of ocular peduncle. Antennule with 48–53 flagellar exopod and 2 endopodal segments. Antenna with 5–6 flagellar segments; acute spine on dorsolateral surface of peduncle segment I. Dactyli of pereopods II, III with heels low and smoothly rounded. Coxa of pereopod III of males with small male pore. Telson of male spatulate, laterally expanded, dorsoventrally flattened; produced slightly at tip. Telson of female flattened, rounded at tip.

Redescription.—Carapace (Fig. 3a) slightly wider than long. Anterior margin concave on either side of ocular sinus, becoming convex laterally with 10–12 large and 3–4 small spines along length. Rostrum a small acute tooth, reaching just beyond proximal margin of ocular plate. Ocular sinus smoothly concave, unarmed. Frontal region smooth; setal field broad posteriorly, narrowing anteriorly, with narrow anterior lateral elements and concave anterior margin; posterior lateral elements reaching to posterior lateral elements of CG1. Medial portion of CG1 parallel to anterior margin of carapace, sinuous, slightly crenulate, divided into medial fragment and curved posteriorly-displaced lateral elements, but with medial and lateral elements connected by posterior lateral elements of setal field. Mesogastric region smooth; CG2 short, with 1–2 elements; CG3 broken into 2 longer lateral elements and 1–3 short medial elements; CG4 with 2–3 short medial elements displaced anteriorly, with gap at midline between short elements. Hepatic region smooth with long setose groove at median of lateral margin. Epibranchial region approximately triangular, smooth; posterolateral margin with 3 short rows of setae. Metagastric region smooth; CG5 ranging from entire to 4 elements, nearly reaching margins of CG6. CG6 strongly crenulate, strongly anteriorly concave medially and sloping out to anteriorly convex lateral thirds. CG7 nearly straight relative to anterior margin of carapace and separate from CG6. Cardiac region smooth; CG8 with 1–

2 median elements separated from lateral elements. CG9 present as 2 lateral grooves with short gap at midline. CG10 present as 2 curved lateral fragments, with gap between fragments about half length of single fragment. CG11 present. Branchial region with numerous short, transverse rows of setae. Posterior margin deeply and evenly convex, with submarginal groove reaching about half-way either side of posterior concavity. Branchiostegite with short anterior submarginal spine; anterior region with scattered short transverse lines ventral to linea anomurica; with many short rows of setae and sparsely covered with long plumose setae ventrally; posterior region membranous, with numerous irregular fragments, and sparsely covered with long plumose setae.

Ocular plate (Fig. 3b) subquadrate, with broad median indentation; proximal ocular segments (Fig. 3b) reduced to small rounded calcified area on either side of ocular plate. Ocular peduncles (Fig. 3b) elongate, with medially concave lateral margins, tapering to rounded distal corneae; mesial margins approximated along entire length; mesial and ventral margins of peduncle with sparse row of long plumose setae; tuft of plumose setae at proximal lateral ventral angle.

Antennule (Fig. 3c) segment III narrow proximally, expanding distally to twice proximal width; with plumose setae on dorsal and ventral margins; dorsal exopodal flagellum with 48–53 segments and long plumose setae on dorsal and ventral margins; ventral endopodal flagellum short, with 2 segments and plumose setae on dorsal and ventral margins. Segment II medially inflated in dorsal view, with plumose setae on dorsal and ventral margins, and setae scattered on ventrolateral third of surface. Segment I wider than long, unarmed; dorsal third of lateral surface faintly rugose with long plumose setae; long plumose setae on dorsal and ventral margins.

Antenna (Fig. 3d) segment V about 3 times longer than wide, with long plumose

setae on dorsal and ventral margins; flagellum 5–6 segmented, with long plumose setae on dorsal, ventral and distal margins. Segment IV expanded distally, with long plumose setae on dorsal, ventral and distal margins, and row of setae on dorsolateral margin. Segment III with long plumose setae on ventral margin. Segment II short, widening distally, with plumose setae on margins; antennal acicle long, thin, reaching to distal margin of segment IV, with long plumose setae on dorsal margin. Segment I rounded proximally, flattened ventrolaterally with long plumose setae on margins; lateral surface with acute spine dorsally, with low semicircular dorsolateral lobe ventrodorsal to spine; segment with ventromesial antennal gland pore.

Mandible (Fig. 3e) incisor process with 1 tooth; cutting edge with 1 tooth. Molar process with 1–2 teeth. Palp 3-segmented, with plumose setae on margins and long, thick, simple setae arising from bend in second segment.

Maxilla (Fig. 3f) exopod evenly rounded, with plumose setae along distal margin. Scaphognathite bluntly angled on posterior lobe, with plumose setae. Endopod and endites without distinctive characters.

Maxillule (Fig. 3g) distal endite proximally narrow, widening to inflated distal end, with thick simple setae on distal margin. Proximal endite with thick simple setae on distal margin. Endopodal external lobe truncate distally and curled under; internal lobe reduced, with 3 thick setae at distolateral margin.

Maxilliped I (Fig. 3h) epipod with plumose setae on distal margin and distolateral surface. Endite tapered distally, subequal to first segment of exopod. Exopod with 2 segments; proximal segment narrow, margins parallel and with plumose setae; distal segment spatulate, about as long as wide, broadest medially, margins with long plumose setae. Endopod flattened and elongate, reaching to distal end of proximal exopodal segment; with plumose setae on margins.

Maxilliped II (Fig. 3i) dactylus evenly rounded, length equal to width, with thick simple setae distally. Propodus 1.5 times wider than long, with plumose setae on dorsal margin and long simple setae on distal margin. Carpus not strongly produced dorsodistally, about 2 times longer than wide, with long simple setae on dorsal margin. Merus about 3 times longer than wide, margins parallel, with simple setae on ventrolateral margin and plumose setae on dorsolateral margin. Basi-ischium incompletely fused, with plumose setae on margins. Exopod $\frac{1}{4}$ times longer than merus, with flagellum 1-segmented.

Maxilliped III (Fig. 3j) dactylus evenly rounded; with long plumose setae on dorsal margin and lateral surface. Propodus with longitudinal median row of plumose setae on lateral surface; dorsal margin with plumose setae. Carpus slightly produced onto propodus; lateral surface with row of plumose setae ventromedially; plumose setae on dorsal margin. Merus unarmed, with plumose setae on all margins. Basi-ischium incompletely fused, without crista dentata. Exopod 2-segmented, proximal segment small; distal segment styliiform, tapering, approximately $\frac{1}{3}$ length of merus, with plumose setae scattered on surface; without flagellum.

Pereopod I (Fig. 4a) subchelate. Dactylus curved and tapering; lateral and mesial surfaces smooth; dorsal margin with long plumose and short simple setae; ventral margin with short simple setae. Propodus lateral surface with numerous short, transverse rows of setose rugae; dorsal margin unarmed; ventral margin produced distally into acute spine; cutting edge lacking teeth, lined with long plumose setae; dorsal margin with long plumose setae, ventral margin with short simple setae. Carpus dorsodistal angle produced into strong corneous-tipped spine, dorsal margin with few large and small spines posteriorly along distal third; dorsal and distal margins with long plumose setae; lateral surface with small distal rugose area, with few transverse setose

ridges on distal half of surface; mesial surface smooth with few scattered rows of long plumose setae, dorsal and ventral margins with long plumose setae. Merus unarmed; lateral surface with scattered transverse rows of long plumose setae, dorsal, ventral and distal margins with long plumose setae; mesial side with few short rows of setae. Basi-ischium incompletely fused, unarmed. Coxa unarmed.

Pereopods II–IV dactyli laterally compressed and dorsoventrally expanded.

Pereopod II (Fig. 4b) dactylus smooth; with base to heel straight, heel smoothly rounded, heel to tip with rounded broad indent, tip acute, tip to base broadly convex; lateral surface smooth, with several small tufts of short setae in approximately straight line across medioproximal surface, several widely-spaced submarginal tufts of short setae dorsodistally; mesial surface smooth, ventral margin with long plumose setae, dorsal margin with short simple setae, with patch of long plumose setae at base. Propodus dorsal surface smooth, ventral margin inflated and rounded; oblique row of long plumose setae on distal margin of lateral surface; distal and ventral margins with long plumose setae; dorsolateral surface a narrow, oblique, flattened shelf, with short setae on dorsal margin and long plumose setae on ventral margin; mesial surface with elevated, curved, setose ridge from ventral junction with dactylus almost to ventral proximal junction with carpus. Carpus slightly produced dorsodistally; lateral surface nearly smooth, with irregular broken row of rugae and submarginal elevated ridge ventrally, rugae and ridge with long plumose setae; dorsodistal projection with mat of short setae on lateral surface; margins with long plumose setae; mesial surface smooth with long plumose setae in scattered patches on surface, and on margins. Merus lateral surface with large decalcified window and few scattered setae on surface and margins; mesial surface nearly smooth with few setae. Basi-ischium in-

completely fused, unarmed. Coxa with small spine on anterior margin.

Pereopod III (Fig. 4c) dactylus with base to heel straight, heel broadly rounded and low, heel to tip with broad evenly rounded indent, tip acute, tip to base smoothly convex to straight; lateral surface smooth, with several small tufts of short setae in roughly straight line across medioproximal surface, dorsodistal margin with tufts of short setae; ventromesial margin with long plumose setae, dorsal margin with short simple and plumose setae; mesial surface smooth, with plumose setae proximally at junction with propodus. Propodus not inflated dorsoventrally; lateral surface smooth, with long plumose setae distally, with simple setae on dorsal margins, and long plumose setae on ventral margin; dorsolateral surface narrow, oblique, flattened; mesial surface with scattered long setae on and near distal margin. Carpus produced dorsodistally, exceeding proximal margin of propodus by about $\frac{1}{4}$ length of propodus, pointed but not acute; dorsolateral margin unarmed; lateral surface slightly rugose dorsodistally, with mat of short setae and 2 longer rows of setae ventrally; mesial surface smooth, with long plumose setae on margins and scattered on surface. Merus smooth with large decalcified window; dorsal and ventral margins unarmed, with long plumose setae; laterodistal margin with long plumose setae; mesial surface smooth. Basi-ischium incompletely fused and unarmed. Coxa unarmed. Female with large gonopore on anterior mesial surface of coxa, surrounded with short plumose setae; male with small pore on coxa.

Pereopod IV (Fig. 4d) dactylus with base to tip proximally convex becoming concave, heel and indent absent, tip acute, tip to base straight distally becoming convex proximally; lateral surface smooth, ventral margin with long plumose setae, dorsal margin with short simple setae; mesial surface with dorsal decalcified window, demarcated ventrally by longitudinal elevated ridge bearing row of short setae; with setose

punctae ventral to decalcified window. Propodus expanded dorsally and ventrally; ventral expansion exceeds ventral margin of dactylus, margin with long plumose setae; dorsal expansion with row of long plumose setae medially; lateral and mesial surfaces smooth. Carpus not produced dorsodistally; lateral and mesial surfaces smooth; dorsal margin with short simple and long plumose setae; ventral margin with short simple setae; mesial surface with decalcified window. Merus lateral surface with scattered short transverse rows of setae, dorsal and ventrodorsal margins with long plumose setae; mesial surface with large decalcified window proximovertrally. Basi-ischium incompletely fused and unarmed. Coxa unarmed.

Pereopod 5 reduced, slender, lacking distinctive features. Coxa of male with large mesioproximal gonopore.

Abdomen (Fig. 4e) somite I approximately as long as wide, widest posteriorly; dorsal surface with anterior margin straight; posterior margin straight, with elevated submarginal row of short setae; with small transverse decalcified windows laterad to segment midline. Somite II dorsal surface with submarginal transverse ridge anteriorly; with small transverse decalcified windows laterad to segment midline just anterior to submarginal ridge; with tuft of setae at posterolateral angle, extending onto pleura posteromesially; posterior margin with indistinct punctate submarginal groove laterally; pleura expanded and directed slightly anteriorly; lateral margins rounded, anterior and lateral margins with long plumose setae, posterior margin with short setae. Somite III similar to somite II, but narrower, shorter, and lacking anterior submarginal ridge; small tuft of short thick setae on posterolateral angle; pleura thinner and shorter than on somite II, directed anterolaterally, with setae as in somite II; anterolateral angle acute; dorsal surface obliquely flattened anterolaterally. Somite IV similar to somite III, but thinner and shorter; dorsal surface with thick setae pos-

terolaterally; pleura thinner and shorter than on somite III, directed posterolaterally; dorsal surface obliquely flattened anterolaterally; margin with long plumose setae. Somite V narrower than somite IV; lateral margins with short plumose setae; pleura absent. Somite VI subequal to somite V in width but longer; dorsal surface with short transverse rows of setae laterad to midline anteriorly; lateral margins with long plumose setae; pleura absent.

Females with uniramous, paired pleopods on somites II–V; males lacking pleopods.

Uropods lacking distinctive features.

Telson of male (Fig. 4f) spatulate, laterally expanded, with length subequal to width, produced into short rounded tip distally; weakly calcified except for large triangular anterior plate; median longitudinal groove long, extending to distal end of calcified plate, lined with long thin simple setae; calcified plate slightly elevated medially but without ridge. Telson of female (Fig. 4g) ovate, longer than wide, broadly triangular, dorsal surface smooth, with median longitudinal groove anteriorly; with row of setose punctae lateral to midline from median of longitudinal groove to distal end of groove; margins with long plumose setae.

Coloration.—Off-white with whitish setae in life and in preservative.

Distribution.—Indo-West Pacific: Hawaii; Western Australia; Seychelles; Maldives; 3.7–13.7 m.

Remarks.—This species can easily be separated from all of the other Indo-West Pacific species of *Albunea*, except *A. madagascariensis*, by the concave shape of the lateral margins of the eyes. Although a direct comparison of *A. speciosa* with *A. madagascariensis* material is desirable, the types (and only known specimens) of *A. madagascariensis* apparently were not deposited in the Muséum National d'Histoire Naturelle (MNHN), contrary to Thomassin (1973) (Nguyen, pers. comm.). Nevertheless, based on Thomassin's (1973) description and illustrations, the two species can

tentatively be separated by several characters. *A. speciosa* has a short rostrum that does not reach the distal margin of the ocular plate, a CG4 comprised of two medial elements, a more truncate heel of pereopod III, and a rounded distal tip on the telson of the male, while *A. madagascariensis* has a long rostrum that well exceeds the distal margin of the ocular plate, a CG4 of 1 medial element, a rounded heel of pereopod III, and a pointed distal tip on the telson of the male. Given a larger sample size, particularly from the westernmost Indo-Pacific, all of these characters may prove to represent only intraspecific variation of *A. speciosa*, in which case *A. madagascariensis* would become a synonym of *A. speciosa*. Two of Thomassin's specimens exhibited a peculiar orange and brown banding pattern (Thomassin 1973: 268, pl. 1). No other species of *Albunea* have been reported with anything but almost uniform coloration, suggesting the possibility that this may have been an artifact of the environment. More study is needed to determine whether this is similar to the type of environmentally-induced color changes observed in mole crabs of the genus *Hippa* Fabricius, 1787 (e.g., Bauchau & Passelecq-Gérin 1987).

Little is known about the biology of this species other than the few records of ovigerous females herein reported. Several *A. speciosa* specimens (QM W22285) were collected together with the holotype of *Albunea danai* new species, but it is unknown if the two species regularly coexist.

Specimens of *A. speciosa* have been reported only three times in the literature (Dana 1852, Borradaile 1904, Serène 1973). Examination of Borradaile's (1904) specimen from the Maldives confirms its identity as this species, making Borradaile's (1904) record the first from outside Hawaii, although his paper was overlooked by subsequent researchers.

Because *A. speciosa* is now known to be a wide-ranging Indo-Pacific species, rather than a Hawaiian endemic, it would be use-

ful to understand the origin and subsequent distribution of this species in order to better understand albuneid biogeography. The Hawaiian specimens of *A. speciosa* are far removed from other populations of this species, a phenomenon that has been shown for other wide-ranging Hawaiian shallow-water fauna with western Indo-Pacific affinities (Newman 1986), and they probably reached the relatively young Hawaiian Islands by long distance dispersal. However, the closest locality where this species has been reported is not from the Philippines or nearby islands in the northern Indo-Pacific, but rather from Western Australia to the south. Unless the species is found on the east coast of Australia or in the island groups to the east, such as the New Hebrides or Society Islands, it is difficult to hypothesize the eastward dispersal route by which *A. speciosa* reached the Hawaiian Islands. A northern or southern dispersal route across the Pacific appears equally likely, given the evidence currently available.

Albunea danai, new species
Figs. 5, 6

Type material.—Holotype: Hawaii, Halonuu Blow Hole dive site, south shore, Oahu, 12.2–13.7 m, coll. R. Holcom, 4 Apr 1997: 1 male, 16.7 mm CL (QM W23105). Allotype: Kailua, Oahu, Mar 1938: 1 female, 16.8 mm CL (BPBM S11782). Paratypes: Waikiki, Oahu, 22.7 m, coll. Smith and Allen, 23 May 1948: 1 male, 11.6 mm CL (BPBM S5343); off Waikiki, Oahu, 6.1 m, coll. Allen and Smith, 30 May 1948: 1 female, 10.8 mm CL (AMNH 17716); Kahana Bay, Oahu, 7.6–9.1 m, coll. "Pele" Expedition, 25 Jul 1959: 1 male, 8.6 mm CL (BPBM S6775); off Sand Island, Oahu, 4.8–7.6 m, coll. "Pele" Expedition, 17 July 1959: 1 male, 10.4 mm CL (AMNH 17717); Diamond Head, Oahu, 7.6–13.6 m, coll. "Pele" Expedition, 9 Sep 1959: 1 female, 13.0 mm CL (BPBM S6777); [Mamala Bay], off Honolulu, Oahu, 27.4–40.2 m, coll. T. Richert, Feb–Mar 1962: 1 male,

16.4 mm CL, 1 female, 15.5 mm CL (WAM 481-97); [Mamala Bay], off Ewa Beach, near Pearl Harbor, Oahu, 27.4 m, coll. B. R. Wilson on R/V "Pele," 5 Jul 1964: 1 ovigerous female, 10.8 mm CL (WAM 143-70).

Additional material examined (non type).—Hawaii: Kanoeh Bay, Oahu, 1924: 1 male (poor condition), 4.0 mm CL (BPBM S7806).

Type locality.—Halonuu Blow Hole dive site, south shore, Oahu, Hawaii, USA, Pacific Ocean.

Diagnosis.—Carapace slightly longer than wide, covered with lightly setose grooves. Anterior margin with 8–9 teeth. Setal field with narrow lateral elements and slightly concave anterior margin; posterior lateral elements not extending to posterior lateral elements of CG1. CG1 with separate posterior lateral elements; CG4 with 2–4 short medial elements; CG5 divided into 2 lateral elements, not nearly reaching margins of CG6; CG6 and CG7 separate, but almost approximate; CG8 with 1–2 posteriorly displaced median elements separated from lateral elements; CG11 absent. Rostrum present, not reaching proximal margin of ocular plate. Ocular plate subquadrate. Ocular peduncles dorsoventrally flattened and elongate, pointed at tip, approximate along mesial margin; lateral margin convex; mesial margin straight proximally, convex distally. Cornea at lateral margin of tip. Antennule with 87–92 flagellar exopodal and 3–4 endopodal segments. Antenna with 7 flagellar segments; acute spine on dorsolateral surface of peduncle segment I. Dactyli of pereopods II, III with heels low and smoothly rounded. Coxa of pereopod III of males with small male pore. Telson of male triangular, dorsoventrally flattened laterally and distally, inflated medially. Telson of female flattened, rounded at tip.

Description.—Carapace (Fig. 5a) slightly wider than long. Anterior margin slightly concave on either side of ocular sinus, becoming convex laterally, with 8–9 large spines along length. Rostrum a small acute

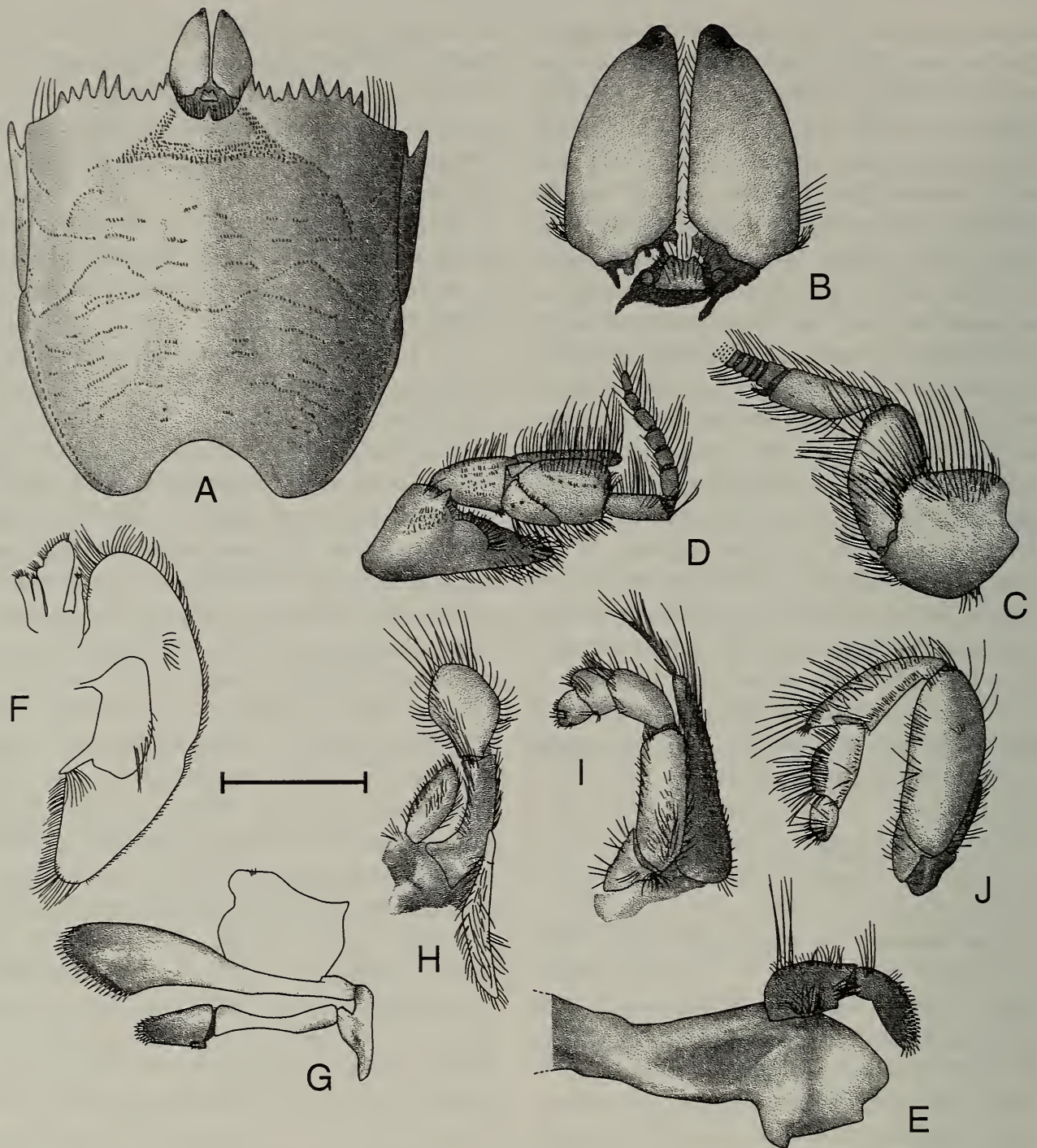


Fig. 5. *Albunea danai*, new species. A, male, 16.7 mm CL, QM W23105, holotype; B–F, H–J, ovig. female, 10.8 mm CL, WAM 143-70; G, male 11.6 mm CL, BPBM 5343. A, carapace and eyes, dorsal view; B, eyes, dorsal view; C, left antennule, lateral view; D, right antenna, lateral view; E, left mandible, lateral view; F, left maxilla, lateral view; G, left maxillule, lateral view; H, left maxilliped I, lateral view; I, left maxilliped II, lateral view; J, left maxilliped III, lateral view. Scale = 1.2 mm (C, D, F, H, J), 1.6 mm (B, E, G), 2.2 mm (I), and 6.7 mm (A).

tooth, extending only half the distance between distal margin of ocular sinus and ocular plate. Ocular sinus smoothly concave and unarmed. Frontal region smooth; setal field broad posteriorly, narrowing anteriorly, with narrow anterior lateral elements and slightly concave anterior margin; posterior

lateral elements thin and not reaching to posterior lateral elements of CG1. CG1 medial portion parallel to anterior margin of carapace, faintly sinuous, strongly crenulate, divided into medial fragment and curved, posteriorly displaced lateral elements. Mesogastric region smooth; CG2

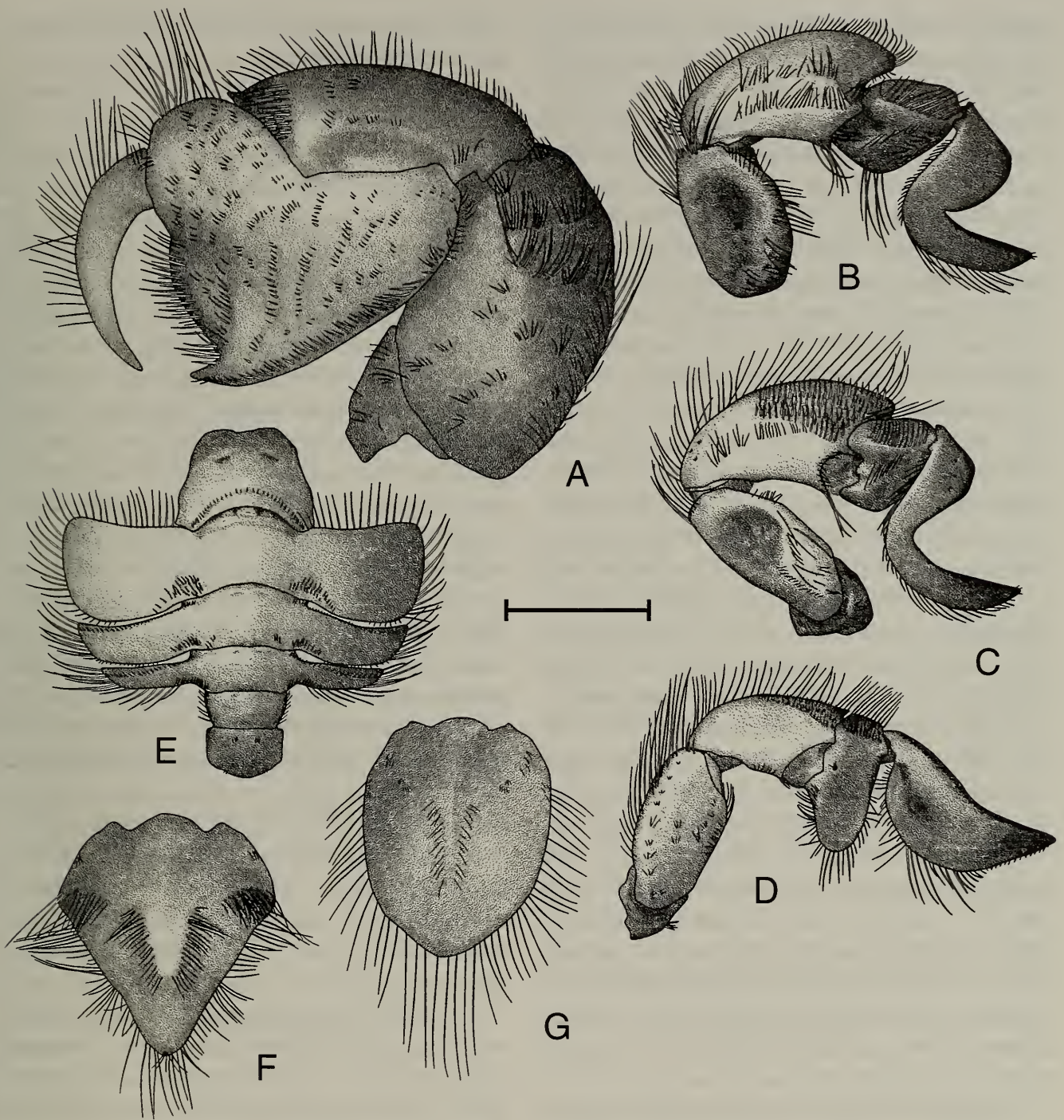


Fig. 6. *Albunea danai*, new species. A, F, male, 16.7 mm CL, QM W23105, holotype; B-E, male 11.6 mm CL, BPBM 5343; G, female, 16.8 mm CL, BPBM S11782, allotype. A, left pereopod I, lateral view; B, right pereopod II, lateral view; C, right pereopod III, lateral view; D, right pereopod IV, lateral view; E, abdominal somites I-VI, dorsal view; F, telson of male, dorsal view; G, telson of female, dorsal view. Scale = 3.0 mm (F, G) and 4.4 mm (A-E).

absent; CG3 broken into 6 short elements approximately equally spaced between posterior lateral elements of CG1; CG4 with 2-4 short medial elements spaced approximately equally between longer lateral elements of CG4. Hepatic region smooth with oblique setose groove at median of lateral margin. Epibranchial region roughly trian-

gular, smooth; posterolateral margin with 2 short rows of setae. Metagastric region smooth; CG5 divided into 2 short lateral elements. CG6 strongly crenulate, strongly anteriorly concave medially and sloping out to anteriorly convex lateral thirds, median and lateral thirds separated by short setae-free gap lateral to small depressions. CG7

oblique, almost reaching lateral margins of median segment of CG6. Cardiac region smooth; CG8 present as 2 very short lateromedial elements displaced posteriorly from longer lateral elements. CG9 present as 2 short lateral grooves with gap at midline. CG10 present as 2 curved lateral fragments, with gap between fragments approximately equal to length of single fragment. CG11 absent. Branchial region with numerous short, transverse rows of setae. Posterior margin deeply and evenly convex, with submarginal groove reaching about half-way either side of posterior concavity. Branchiostegite with short anterior submarginal spine; anterior region with scattered short transverse lines ventral to linea anomurica; with many short rows of setae and sparsely covered with long plumose setae ventrally; posterior region membranous with numerous, irregular fragments and sparsely covered with long plumose setae.

Ocular plate (Fig. 5b) subquadrate with narrow indentation; proximal ocular segments (Fig. 5b) reduced to small rounded calcified area on either side of ocular plate. Ocular peduncle (Fig. 5b) elongate, with medially convex lateral margins, tapering to rounded distal cornea located in lateral notch; mesial margin approximate almost all of length; mesial and proximolateral margins of segment with sparse row of long plumose setae; tuft of plumose setae at proximolateral ventral angle.

Antennule (Fig. 5c) segment III narrow proximally, expanding distally to twice proximal width; with plumose setae on dorsal and ventral margins and sparsely scattered on lateral surface; dorsal exopodal flagellum with 87–92 segments and long plumose setae on dorsal and ventral margins; ventral endopodal flagellum short, with 3–4 segments and plumose setae on dorsal and ventral margins. Segment II medially inflated in dorsal view, with plumose setae on dorsal and ventral margins and scattered setae on ventrolateral third of surface. Segment I wider than long, unarmed; dorsal third of lateral surface rugose with long plu-

mose setae; long plumose setae on dorsal and ventral margins.

Antenna (Fig. 5d) segment V about 2 times longer than wide, with long plumose setae on dorsal margin and scattered setae on distal half of lateral surface; flagellum 7-segmented, with long plumose setae on dorsal, ventral and distal margins. Segment IV expanded distally with long plumose setae on dorsal, ventral and distal margins, and 2 rows of setae on dorsolateral surface. Segment III with long plumose setae on dorsal and ventral margin. Segment II short, widening distally, with plumose setae on margins and scattered on lateral surface; antennal acicle long, thin and exceeding distal margin of segment IV by $\frac{1}{4}$ the length of segment IV, with long plumose setae on dorsal margin. Segment I rounded proximally, flattened ventrolaterally, with long plumose setae on margins; lateral surface with acute spine dorsally, with low semi-circular dorsolateral lobe ventrodorsal to spine; segment with ventromesial antennal gland pore.

Mandible (Fig. 5e) incisor process with 1 tooth; cutting edge with 1 tooth. Molar process with 2–3 teeth. Palp 3-segmented, with plumose setae on margins and long, thick, simple setae arising from bend in second segment.

Maxilla (Fig. 5f) exopod evenly rounded, with plumose setae along distal margin. Scaphognathite bluntly angled on posterior lobe, with plumose setae. Endopod and endites without distinctive characters.

Maxillule (Fig. 5g) distal endite proximally narrow, widening to inflated distal end, with thick simple setae on distal margin. Proximal endite with thick simple setae on distal margin. Endopodal external lobe truncate distally, and curled under; internal lobe reduced, with 3 thick setae at distolateral margin.

Maxilliped I (Fig. 5h) epipod with plumose setae on margins, distolateral surface and mesial surface (epipod shown curled in Fig. 5h). Endite tapered distally and subequal to first segment of exopod. Exopod

with 2 segments; proximal segment narrow, margins parallel, margins with plumose setae; distal segment spatulate, about as long as wide, broadest medially, margins and mesioventral surface with long plumose setae. Endopod flattened and elongate, reaching to distal end of proximal exopodal segment; plumose setae on margins and median of lateral surface.

Maxilliped II (Fig. 5i) dactylus evenly rounded, length equal to width, with thick simple setae distally and on distolateral surface. Propodus 2 times wider than long, slightly produced at dorsodistal angle, with plumose setae on dorsal margin and long simple setae on dorsodistal margin. Carpus not produced dorsodistally, about 2 times longer than wide; long simple setae on dorsal and distal margins. Merus about 3 times longer than wide, margins parallel; with simple setae on ventrolateral margin and plumose setae on dorsolateral margin. Basi-ischium incompletely fused, plumose setae on margins. Exopod $\frac{1}{3}$ times longer than merus, with flagellum 1-segmented.

Maxilliped III (Fig. 5j) dactylus with rounded tip; with long plumose setae on dorsal margin and lateral surface. Propodus with longitudinal median row of plumose setae on lateral surface; dorsal margin with plumose setae. Carpus slightly produced onto propodus; lateral surface with row of plumose setae ventromedially; plumose setae on dorsal margin. Merus unarmed, with plumose setae on dorsal and ventral margins and scattered on lateral surface. Basi-ischium incompletely fused, with weak crista dentata of about 2 teeth. Exopod 2-segmented: proximal segment small; distal segment styliform, tapering, approximately $\frac{1}{3}$ length of merus; with plumose setae on surface; without flagellum.

Pereopod I (Fig. 6a) subchelate. Dactylus curved and tapering; lateral and mesial surfaces smooth; dorsal margin with long plumose and short simple setae; ventral margin with short simple setae. Propodus lateral surface with numerous short, transverse rows of setose rugae; dorsal margin un-

armed; ventral margin produced distally into acute spine; cutting edge lacking teeth, lined with long plumose setae; dorsal margin with long plumose setae, ventral margin with short simple setae. Carpus with dorsodistal angle produced into strong corneous-tipped spine; dorsal margin otherwise unarmed; dorsal and distal margins with long plumose setae; lateral surface with small distal rugose area, with few transverse setose ridges on distal half of surface; mesial surface smooth with few median rows of setae, margins with long plumose setae. Merus unarmed; lateral surface with scattered transverse rows of long plumose setae, margins with long plumose setae; mesial side with few short rows of setae. Basi-ischium incompletely fused, unarmed. Coxa unarmed.

Pereopods II–IV with dactyli laterally compressed and dorsoventrally expanded.

Pereopod II (Fig. 6b) dactylus smooth; base to heel straight, heel smoothly rounded, heel to tip with wide acute indent, tip acute, tip to base broadly convex distally and slightly concave proximally; lateral surface smooth, with several small tufts of short setae in roughly straight line across medioproximal surface, several widely spaced submarginal tufts of short setae dorsodistally; mesial surface smooth, ventral margin with long plumose setae, dorsal margin with short simple setae, with patch of long plumose setae at base. Propodus dorsal surface smooth, ventral margin inflated and rounded; oblique row of long plumose setae on distal margin of lateral surface; distal and ventral margin with long plumose setae; dorsolateral surface a narrow, oblique, flattened shelf, with short setae on dorsal margin and long plumose setae on ventral margin; mesial surface with elevated, curved setose ridge from ventral junction with dactylus almost to ventral proximal junction with carpus. Carpus produced and gently rounded dorsodistally, dorsal margin unarmed; lateral surface smooth, with irregular broken row of rugae and submarginal elevated ridge ventrally,

rugae and ridge with long plumose setae; margins with long plumose setae; mesial surface smooth with long plumose setae in scattered patches on dorsal half of surface and on margins. Merus with large median decalcified window covering nearly all of lateral surface, with few scattered setae on surface and margins; mesial surface nearly smooth with few setae, with decalcified area on proximal $\frac{1}{4}$ near junction with basi-ischium. Basi-ischium incompletely fused and unarmed. Coxa with small spine on anterior margin.

Pereopod III (Fig. 6c) dactylus with base to heel straight, heel broadly rounded and slightly produced, heel to tip with broadly concave indent, tip acute, tip to base smoothly convex distally to straight proximally; lateral surface smooth, with several small tufts of short setae in approximately straight line across medioproximal surface, dorsodistal margin with tufts of short setae; ventral margin with long plumose setae, dorsal margin with short simple and plumose setae; mesial surface smooth with plumose setae proximally at junction with propodus. Propodus not inflated dorsoventrally; lateral surface smooth, with long plumose setae distally, with simple setae on dorsal margins; dorsolateral surface narrow, oblique, flattened; mesial surface with scattered long setae on and near distal margin. Carpus produced dorsodistally, exceeding proximal margin of propodus by about $\frac{1}{3}$ length of propodus, rounded; dorsolateral margin unarmed; lateral surface slightly rugose dorsodistally, with mat of short setae and row of setae ventrally; mesial surface smooth, with long plumose setae on margins and scattered on surface. Merus smooth, with large decalcified window covering nearly half of lateral surface medially; dorsal and ventral margins unarmed, with long plumose setae; laterodistal margin with long plumose setae; mesial surface smooth. Basi-ischium incompletely fused and unarmed. Coxa with tubercle on anterior margin. Female with large gonopore on anterior mesial margin of coxa, surrounded

with short plumose setae; male with small pore on coxa.

Pereopod IV (Fig. 6d) dactylus with base to tip proximally convex becoming distally concave, heel and indent absent, tip acute, tip to base straight distally, becoming convex proximally; lateral surface smooth, ventral margin with long plumose setae, dorsal margin with short simple setae; mesial surface with dorsal decalcified window, demarcated ventrally by longitudinal elevated ridge with row of short setae; with setose punctations ventral to decalcified window. Propodus expanded dorsally and ventrally; ventral expansion exceeds ventral margin of dactylus, margin with long plumose setae; dorsal expansion with row of long plumose setae medially; lateral and mesial surfaces smooth. Carpus not produced dorsodistally; ventral $\frac{3}{4}$ of lateral surface and mesial surface smooth, dorsal $\frac{1}{4}$ of lateral surface with mat of short setae; mesial surface with decalcified window; dorsal margin with short simple and long plumose setae; ventral margin with short simple setae. Merus lateral surface with scattered short transverse rows of setae, dorsal and ventrodistal margins with long plumose setae; mesial surface with large decalcified window proximoventrally. Basi-ischium incompletely fused and unarmed. Coxa unarmed.

Pereopod 5 reduced, slender, lacking distinctive features. Coxa of male with large mesioproximal gonopore.

Abdomen (Fig. 6e) somite I approximately as long as wide, widest posteriorly; dorsal surface with anterior margin straight; posterior margin straight with elevated submarginal row of short setae; with small transverse decalcified windows laterad to segment midline. Somite II dorsal surface with submarginal transverse ridge anteriorly; with small transverse decalcified windows laterad to segment midline just anterior to submarginal ridge; with tuft of setae at posterolateral angle, extending onto pleura posteromesially; pleura expanded and directed slightly anteriorly; lateral margins

rounded, anterior and lateral margins with long plumose setae, posterior margin with short setae. Somite III similar to somite II, but narrower, shorter, and lacking anterior submarginal ridge; small tuft of short thick setae on posterolateral angle; pleura thinner and shorter than on somite II, directed posterolaterally, with setae as in somite II; anterolateral angle acute; dorsal surface obliquely flattened anterolaterally. Somite IV similar to somite III, but thinner and shorter; dorsal surface with few thick setae posterolaterally; pleura thinner and shorter than on somite III, directed posterolaterally; dorsal surface obliquely flattened anterolaterally; margins with long plumose setae. Somite V subequal to somite IV; lateral margins with plumose setae; pleura absent. Somite VI subequal to somite V in length but wider; dorsal surface with short transverse rows of setae laterad to midline anteriorly and posteriorly; lateral margins with long plumose setae; pleura absent.

Females with uniramous, paired pleopods on somites II–V; males without pleopods.

Uropods lacking distinctive features.

Telson of male (Fig. 6f) triangular, slightly longer than wide, with smoothly rounded tip; proximal half heavily calcified, distal half weakly calcified except for large median region; median longitudinal groove extending to distal end of calcified area, line with long thin simple setae; junction of proximal and distal regions demarcated by strong line of long setae laterally; calcified plate slightly elevated medially but without ridge. Telson of female (Fig. 6g) ovate, longer than wide, rounded distally; dorsal surface smooth, with median longitudinal groove anteriorly; with row of setose punctae lateral to midline from posterior end of longitudinal groove to $\frac{3}{4}$ length of telson; margins with long plumose setae.

Coloration.—In life, brownish with reddish-brown setae. Preserved, uniform off-white to tan.

Distribution.—Known only known from Oahu, Hawaii; 4.8–40.2 m.

Etymology.—Named after James D.

Dana (1813–1895), famed carcinologist and describer of *A. speciosa*, and many other species of Indo-Pacific Crustacea. Gender: masculine.

Remarks.—This species is most similar to *A. carabus* (Linnaeus, 1758), from the Mediterranean and western Africa, in the shape of the dactyli of pereopods II–IV and telson morphology. *Albunae carabus* can be easily separated from *A. danai*, new species, by its CG8 of four medial elements, more strongly crenulated CGs, more pronounced heel on the dactyli of pereopods II and III, and a less inflated maxilliped III merus. *A. danai* new species can be distinguished from other Indo-West Pacific species by the triangular shape of the telson of the male, the rounded dactyl of pereopod III, and setal patterns on the carapace of both sexes. All other species of *Albunea* from the Indo-West Pacific region with smoothly rounded heels on pereopod III (e.g., *A. speciosa*) also have much more strongly setose carapace grooves than *A. danai*, new species, and distinctive male telson morphologies.

As previously indicated, the holotype was collected with specimens of *A. speciosa* (QM W22285).

This species, unlike *A. speciosa*, appears to be a true Hawaiian endemic based on all available data. However, this conclusion should be accepted cautiously, given the “endemic” label applied to *A. speciosa* prior to this study and that endemism appears to be the exception, rather than the rule, in the Hawaiian biota (Newman 1986). As a whole, the Hawaiian albuneids seem to fit in the category of attenuated Indo-West Pacific fauna (Newman 1986), given the markedly greater diversity of albuneids (17 species in six genera) throughout the rest of the Indo-West Pacific.

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